Mathematical Model of Free Convection Boundary Layer Flow on Solid Sphere with Viscous Dissipation and Thermal Radiation

Muhammad Khairul Anuar Mohamed[a], Mohd Zuki Salleh[a], Abid Hussanan[a], Norhafizah Md Sarif[a], Nor Aida Zuraimi Md Noar[a], Anuar Ishak[b], Basuki Widodo[c]

[a]Applied & Industrial Mathematics Research Group, Fakulti Sains & Teknologi Industri, Universiti Malaysia Pahang, 26300 UMP Kuantan, Pahang, Malaysia

[b]School of Mathematical Sciences, Fakulti Sains & Teknologi, Universiti Kebangsaan Malaysia, 43600 UKM Bangi, Selangor, Malaysia.

[c]Department of Mathematics, Institut Teknologi Sepuluh Nopember, Surabaya, Indonesia

ABSTRACT

Present study considers the mathematical modeling of free convection boundary layer flow and heat transfer on a solid sphere with viscous dissipation and thermal radiation effects. The transformed partial differential equations are solved numerically by using the Keller-box method. Numerical solutions are obtained for the reduced Nusselt number, the local skin friction coefficient, the velocity and temperature profiles. The features of the flow characteristics for various values of the Prandtl number, radiation parameter and Eckert number are discussed. It is worth mentioning that the results are obtained until x=180 degree. This is contrary to the previous report where the separation boundary layer flow occurs after x=120 degree. The results in this paper is important for the researchers working in the area of boundary layer flow and this can be used as reference and also as complement for comparison purposes in the future.

KEYWORDS: Mathematical modeling, free convection boundary layer flow, solid sphere, viscous dissipation, thermal radiation